Test Bench

The Perception Is Reality

You would be hard-pressed to find an automotive technician who has not used an oscilloscope to diagnose a particular problem. Most technicians either own a scope or are planning to buy one in the near future. But with so many different scopes available to the automotive repair industry, how will you select the scope that best suits your needs?

If you are not familiar with using an oscilloscope, you may want to select a scope that has preset default setting for most of the items you will use it for. Preset default settings save time, while also helping the technician to become familiar with voltage, time, and trigger setting. It is equally important that the default settings be adjustable and that the adjustments can be saved for later references.

Do you need a hand-held scope that will handle ignition? If so, then the scope that you choose should have adequate primary and secondary ignition capability for most vehicle ignition systems. Remember that all of the digital storage oscilloscopes presently marketed for automotive use do not have the same ignition capabilities.

First Impressions Of The Perception

This month we turn our attention to the OTC Perception, a digital storage oscilloscope (DSO). Additional versions of the Perception are sold by MAC Tools (MAC Wave Enhanced), MATCO Tools (Reality), and Cornwell Tools (Tech Trace). Other than slight differences in appearance, such as the color of the outside case or the shape of the buttons on the control panel, all versions of the tool function exactly the same.

The Perception is equipped with everything needed to view automotive waveforms including:

- Six AA Alkaline batteries
- Test Leads
- AC Adapter
- Ignition Capacitive Probe for secondary ignition
- Carrying Case
- Scope User Manual and Video

Refer to the photo that begins this article for a look at the Perception's accessories.

Figure 1

Perception Controls

Using The Perception

In this section, we'll give you a quick tour of the Perception's basic controls. Before you purchase this or any other DSO, we would suggest that you do a hands-on trial of the scope under actual working conditions, in your shop. All DSOs have their own personalities, and there's no better way to decide whether that personality is compatible with yours than to hold the scope in your own two hands.

Located just below the Perception screen are the four-way arrow keys used to move the highlighter selector (**Figure 1**). Enter and Exit buttons are located on both the left and the right of the arrow keys, which allows the user to access the controls with either hand. Below the four-way arrow keys are the two Change Setting keys for changing the settings of the scope, graph, and multimeter. Located to the left of the Change Setting keys are the Light button (back light on/off), Help button, and Power button. The two controls located to the right of the Change Setting keys are the Hold button and the Glitch button.

Turning on the Perception will automatically bring up the Main Menu consisting of Component Tests, Single Display, Dual Display, Advanced Setup, and Glossary (**Figure 2**). Selecting Single Display or Dual Display will automatically put you into the manual scope mode. Selecting Component Tests opens the Component Tests menu, which consists of Sensors, Actuators, Electrical, and Ignition.

Selecting an item from the Component Tests Menu (**Figure 3**) will open additional submenus. For instance, selecting Actuators will open an Actuator Tests menu (**Figure 4**) consisting of Injector PFI/MFI (saturated switch type), Injector TBI (peak and hold type), Injector PNP, Mixture Ctrl Sol, EGR Ctrl Sol, IAC Step Motor, IAC Motor, IAC Sol, Trans Shift Sol, Turbo Boost Sol, and Glow Plug Amps. All submenu items originating from the Component Tests menu have preset default time, voltage and trigger settings, meaning that selecting an item from either the

Figure 2

Main Menu

Figure 3

Component Menu

Sensors, Actuators, Electrical, or Ignition menu will automatically set the scope's voltage, time, trigger level and slope for optimum acquisition and viewing of the waveform for that particular device.

Figure 4

Actuator Tests Menu

Figure 5

TBI Waveform

Selecting Injector TBI from the Actuator menu will open the scope display with the voltage, time, trigger level and slope preset to view the most common peak and hold injector patterns. Although the settings are preset, they can be adjusted to better view the waveform. More importantly, the adjustments can be saved as the new default settings.

Sampling An Injector Waveform

The time setting has been preset to 20 mS, meaning that the scope's display is 20 mS wide (**Figure 5**). To decrease the time setting, press the DOWN arrow key until the trigger symbol is highlighted. Then press the RIGHT arrow key until the 20 mS time setting is highlighted. Press the Change Settings DOWN

arrow key once to decrease the time setting to 10 mS. This will widen the injector waveform in respect to the scope's display because less time is displayed. The waveform on a 10 mS scale will appear twice as wide as on a 20 mS scale (**Figure 6**). The available time adjustment range is from 1 mS per display to two seconds per display.

Changing the voltage setting is just as easy as adjusting the time setting. Use the UP arrow key to highlight the volt setting located at the upper left side of the display. Then use the Change Setting key to increase or decrease the voltage setting per display. Increasing the voltage setting decreases the vertical size of the waveform. On the other hand, decreasing the volts per display will increase the height of the waveform, making it appear taller in respect to the display (**Figure 7**).

Figure 6

Changing Waveform Time Base

Figure 7

Changing Voltage Scale

Trigger level voltage and slope are preset as well. Adjusting the trigger level voltage tells the scope at what point to start drawing the trace. The slope can be set to positive or negative, which tells the scope to start the trace on a rising or falling voltage of the waveform. The preset trigger for viewing a peak and hold injector pattern is 5 volts, negative slope. This tells the scope to start the trace when the injector driver pulls the negative side of the injector's winding from battery voltage to 5 volts. This only happens once per injector pulse, unless it is a Bosch-type peak and hold injector, which cycles above and below 5 volts at a high frequency during the hold time.

Normally, a peak and hold injector is pulled to ground (approximately 0-50 mV volts) for a fixed amount of time to allow the injector to open. During this time (peak time), the voltage drop across the injector is equal to battery/charging voltage. The PCM then decreases the voltage drop across the injector while holding the pintle off its seat, using less current than was initially required to lift it.

The Bosch-type peak and hold injector is cycled during current limiting, rather than a direct linear

Figure 8

Peak And Hold Injector Waveform

Figure 9

Dual Tracing Injector and O_2 Sensor

Figure 10

Secondary Ignition Testing

decrease in the voltage drop across the injector. The trigger voltage level would normally need to be adjusted so the scope will not redraw the trace each time the voltage drops to 5 volts during the high frequency hold time. The Trigger Auto Level OFF/ON function located under the Advanced Setup menu eliminates the need to make such trigger adjustments.

When the Trigger Auto Level is turned ON, the scope has the unique ability to recognize the normal characteristics of the waveform and automatically setting the trigger level so that the waveform will appear at the center of the screen. While the Trigger Auto Level is turn ON, it is almost impossible to set the trigger voltage level incorrectly. Turning the Trigger Auto Level OFF, however, will set up the scope so that the trigger level must be set manually.

Some DMMs have the ability to measure saturated switch type injector pulse width but will read incorrectly when measuring peak and hold injector pulse width. The peak time of a peak and hold injector waveform does not change. This amount of time is physically required to open the injector. Only the hold time varies to control fuel. In most cases a DMM will measure only the peak time, and does not recognize the hold time as part of the injector pulse width. The hold time starts at the rising edge of the first spike and ends at the rising edge of the last spike. The PCM will vary the width of the hold time only. The true pulse width is the combined peak and hold time (**Figure 8**).

Multimeter

The Perception has the ability to simultaneously display both the injector pulse width in mS and the waveform. By highlighting the Meter measurements located in the center of the screen above the scope display, the Change Settings keys can be used to select from several types of measurements.

The Meter measurement selections consist of INJOT (Injector On-Time), INJPK (Injector Peak Voltage), IGNBT (Ignition Burn Time), IGNPV (Ignition Peak Voltage), IGNBV (Ignition Burn Voltage), DWELL, RMP, DUTY (Duty Cycle), WIDTH, PERIOD, FREQ (Frequency), PK-PK (Voltage Peak to Peak), NEG PK (Negative Peak Voltage), POS PK (Positive Peak voltage), ACAVG (AC Average Voltage), and DCAVG (DC Average Voltage). Up to four types of measurements can be viewed simultaneously with the scope display.

Graphing Capabilities

Because of its graphing and multimeter functions, the Perception is not limited to displaying waveforms. Although nothing replaces an oscilloscope display, I found the graphing capability of the Perception to be particularly useful when dual tracing an injector waveform and an O_2 sensor waveform (**Figure 9**). In the Dual Display mode, the scope's time per display is adjustable, but the time for both displays must be set the same. Adjusting the time per display for Channel 1 also changes the time per display for Channel 2. In most cases this would not be a problem, however the time per display must be set differently when dual tracing an injector waveform and O_2 sensor waveform in order to view an accurate picture of both.

Normally the injector waveform is viewed at approximately 10-20 mS per display. An O_2 sensor waveform cycles much slower, making it difficult to examine in the same time frame. Graphing the O_2 sensor signal voltage gives a much clearer picture of the rich/lean PCM control by allowing the time setting of the graphing display to differ from the time setting of the scope display.

Scoping The Ignition

The Perception will display both primary and secondary ignition waveforms. Some DSOs have signal interference problems when connected to view a primary ignition waveform, which will stall the vehicle by pulling the coil negative low. The Perception has an internal resistance, which prohibits the scope from affecting the negative side of the coil.

Selecting Ignition from the Component Tests menu will bring up the Ignition menu, which consists of PIP/SPOUT, DI Primary, DI Secondary, EI (DIS) Pri and EI (DIS) Sec.

Selecting DI Primary from the Ignition menu will automatically set up the scope's time per display, volts per display, trigger and slope to view the primary ignition waveform of a Distributor type ignition system. Selecting EI (DIS) Pri will set up the scope to view a Distributorless Ignition system's primary ignition waveform. Time, voltage and trigger adjustments can be made to better view the waveform.

To view a secondary ignition waveform, the Capacitive Probe must be connected to the Perception's Channel 1 port and ground port. Because of the wide air gap between the rotor and distributor cap on DI systems, clamping the probe around a spark plug wire will result in an insufficient signal. Clamping the probe around the coil wire (**Figure 10**) provides an inductive signal that is more stable for viewing secondary ignition.

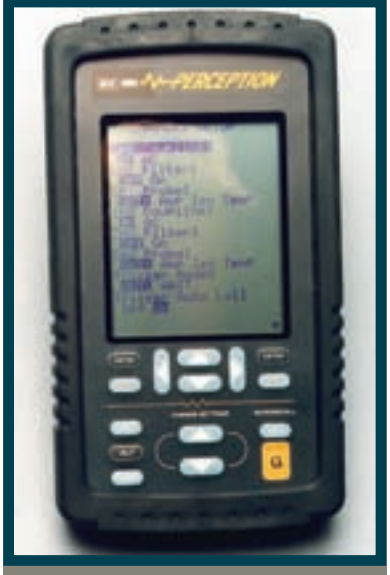
Advanced Settings

The Advanced Setup menu (**Figure 11a-c** on next page) allows the user to manually configure most of the Perception's operating characteristics. Here, the user can couple Channel 1 and/or Channel 2 to AC or DC, select the probe type to be used (Volt, Amp, Ignition, Temp), set the trigger mode to Auto or Wait, and turn Trigger level ON or OFF.

Using the DOWN arrow key to scroll to the bottom of the menu will bring up the next Advanced Setup menu page, which allows the user to adjust the Horizontal Trigger Position, turn the Beeper On or Off, set the mV per A for the low current Amp Probe, select the Temp Scale display F or C, select number of cylinders for dwell measurements, select dwell in degrees or percent duty cycle, select number of sparks per shaft rotation and select the memory locations for glitch capture.

Using the DOWN arrow key to scroll to the bottom of the second page will bring up the final Advanced Setup page, which consists of Sleep Mode On/Off and Contrast adjustments.

Figure 11a



Advanced Setup Menu #1

Figure 11b

Advanced Setup Menu #2

Figure 11c

Advanced Setup Menu #3

Glitch Capture

By far the Perception's most unique feature is its ability to capture a waveform glitch. Using a technology called anomaly triggering, the Glitch Capture has the ability to recognize the normal characteristics of a particular waveform and store the abnormal section of the waveform in the event of a glitch. This means the Perception has the intelligence to recognize the normal characteristics of waveforms that change in both amplitude and frequency such as a wheel speed sensor waveform and trigger on drop outs, and abnormal spikes.

Upgrades

Future upgrades and added options for the Perception will be accomplished via a PC through a modem. This can be accomplished through a Bulletin Board System connection while the Perception is connected to a serial port via a RS232 cable. The Flash EEPROM software can also be downloaded from the company web page, then used to Flash Program the EEPROM of the tool through a RS232 cable. A waveform database (consisting of 75,000 vehicle setups) is being developed for the Perception, and will work in conjunction with OTC's GTI software. This will allow the user to download and store waveforms from the Perception to a PC.

If you would like to receive more information, **Circle No. 126** for the OTC Perception, **Circle No. 127** for the Mac Wave Enhanced, **Circle No. 128** for the Matco Tools Reality, or **Circle No. 129** for the Cornwell Tech Trace on the **Reader Service Card**. ■

—By Mitch Belew

The Perception